B.C.Hydro

# A Study of the Northwestern Alternative Routes for the Kelly Lake-Cheekye 500 kV Double Circuit Transmission Line

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# A STUDY OF THE NORTHWESTERN ALTERNATIVE ROUTES FOR THE KELLY LAKE - CHEEKYE 500 kV DOUBLE CIRCUIT TRANSMISSION LINE

SE 8210

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## SUMMARY

This report answers questions being asked during the Kelly Lake - Cheekye 500 kV transmission line project public consultation program on routes to the northwest of the preferred route described in the Kelly Lake - Cheekye 500 kV Double Circuit Transmission Line Stage I Summary Report, July 1981. Detailed technical evaluation studies were not previously carried out on these routes as initial investigation showed that they were not economical when compared to the route possibilities covered in the Stage I reports. The more detailed technical studies covered in this report confirm that the northwest routes are very expensive when compared to the preferred route due to the longer transmission line routes, the technical diffuculties and the lack of access. As the northwest routes are not considered economical, environmental assessments have not been conducted on them.

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# A STUDY OF THE NORTHWESTERN ALTERNATIVE ROUTES FOR THE KELLY LAKE - CHEEKYE 500 kV DOUBLE CIRCUIT TRANSMISSION LINE

## I. INTRODUCTION

B.C. Hydro is conducting a public consultation program on the proposed Kelly Lake - Cheekye 500 kV Transmission Line project. The public consultation program is primarily based on B.C. Hydro's Kelly Lake - Cheekye 500 kV Double Circuit Transmission Line Stage I Summary Report. The Summary Report discusses the conclusions of the Kelly Lake - Cheekye 500 kV Double Circuit Transmission Line Route Location Report by B.C. Hydro and the Kelly Lake - Cheekye Transmission Line Stage I Environmental Studies Report by Sigma Consultants Ltd. A route for the transmission line which appears to have the least environmental impact and to be the most economical and secure, according to the studies done to that point, is identified as the preferred route in the Summary Report. (see map, Figure 1)

Some of the participants at the public consultation meetings would like the proposed substation, Creekside, and the proposed transmission line route located northwest of the preferred location and alignment. These routes had not been covered in detail in previous reports because preliminary investigations indicated that they would be far more expensive than the preferred route. However to answer the queries, B.C. Hydro has performed

more detailed technical studies on the suggested routes to the northwest. This report explains how the transmission line route will affect the location of the substation, describes technical criteria applied to the evaluation of the routes, presents the route evaluation results, and compares the cost results with the cost of the preferred route.

## II. SUBSTATION SITE ALTERNATIVES

The selection of a site for a major substation is normally dependent on the routing of the transmission lines that are to be connected to it. For this particular case a preferred route for the Kelly Lake - Cheekye circuits and potential routes for possible new transmission from the Central Interior Plateau into the Lower Mainland have been identified. One of the routes into the Lower Mainland would cross the preferred Kelly Lake - Cheekye route near Spetch Creek north of Pemberton. Therefore a substation is planned to be built at Spetch Creek if these routes are used for the two transmission projects.

Using other routes for either Kelly Lake - Cheekye or for transmission into the Lower Mainland could result in development of a substation near Gold Bridge or Donelly Creek rather than at Spetch Creek. The location of a substation to interconnect the two sets of transmission lines would depend on the routing of the lines. If the routes of the two sets of transmission lines were

such that they did not intersect or if one or the other sets of lines were not built then no intermediate interconnecting substation would be required.

Another intermediate substation site suggested is at the planned location of the Meager Creek geo-thermal generating plant. This is not based on its being a possible intersection point of the two transmission systems but rather as a routing that would also provide transmission for the power expected to be generated at Meager Creek. However, the Meager Creek development is contingent on the results of current drilling program and, if it is developed, the success of the pilot plant (proposed for 1988) and then any future drilling in the area. A single 230 kV transmission line is all that will be required to connect the pilot plant into the B.C. Hydro electrical system. The significant extra costs to route the Kelly Lake - Cheekye 500 kV circuits via Meager Creek would not be justified for just the pilot plant since additional development there is uncertain.

All locations mentioned above for alternative substation sites are shown on the map, Figure 1. Exact locations would be decided only when studies for the transmission projects are completed, routes are selected and the need for the substation is established.

## III. ROUTE EVALUATION

The routes, divided into ten segments as shown in Figure 1, were studied and evaluated using maps, aerial photographs and field studies. The segments were compared on the basis of length, construction cost and security.

Construction costs rise when design considerations such as severity of sideslope increase, conductor ice and wind loadings increase and the percentage of changes in direction greater than eight degrees increase. The type of access available, the amount of clearing and clearing methods necessary, and special considerations such as long spans, special foundations, and structure protection also affect construction costs. Although alternate routes may be of comparable length, these factors may make one route more costly.

Security evaluation considers such hazards as snow avalanches, slope failures, floods and river erosion, and extreme ice and wind loadings.

Tables A-1 and A-2, in the Appendix, detail the numerical ratings of the technical evaluation, the value given to each segment, the length and the calculated cost. A description of the technical and security evaluation of each segment is in the next section.

## IV. DESCRIPTION AND ANALYSIS OF ROUTE SEGMENTS

The possible route options are described and analyzed by segment as shown in Figure 1. The ten segments are labelled with capital letters and these points are referred to in the discussion. Only the significant features of the segments are discussed.

### A. Kelly Lake to Mission Ridge (ABDGJ)

This group of segments is the same as the proposed route in the Summary Report and are labelled with the same nomeclature. We will therefore discuss them as one segment.

From Kelly Lake Substation this route parallels the existing 500 kV Circuits 5L41 and 5L42 and existing 230 kV wood pole circuits 2L90 and 2L91 as far as Pavilion (Point D). This area is predominantly flat range land. There are existing roads which provide good access.

The route then crosses the Fraser River parallel to the existing 500 kV circuit 5L42 and continues to parallel it through segments DG and GJ. Roads along the existing transmission line would provide good access in this relatively easy terrain. A short section immediately north of the Bridge River crossing is the only area where the proposed line would not be parallel to the existing line. In this area unstable ground requires that the route for the proposed line deviate slightly from the existing

one.

On Mission Ridge previous studies and existing ice and wind load monitoring on circuit 5L42 indicate that high conductor loadings can be expected. It would therfore be necessary to increase the strength and weight of the transmission towers to accommodate the weight and tensions of the conductor loaded with large amounts of ice exposed to high winds. Two single circuit transmission lines rather than a double circuit line would be required in this area. Once past the heavy loading area the double circuit tower configuration would be resumed.

B. Mission Ridge to Gold Bridge (JU)

From Mission Ridge this route segment would descend into the Carpenter Lake valley, cross Carpenter Lake and head north-west on the north side of the lake to just north of Gold Bridge.

Along Carpenter Lake the line would be located high on ridges to avoid the steep sidehill immediately above the lake. There is a road along the north side of the lake and construction access could be developed from it. Although the terrain is steep along Carpenter Lake there is no avalanche hazard and this portion of the route can be regarded as secure.

C. Kelly Lake to Gold Bridge (ABCEU)

An alternative route leaving Kelly Lake substation would be located on the east side of existing 500 kV circuits 5L41 and 5L42. At point B, approximately 5 kilometres from the substation, the route would head west. After crossing the British Columbia Railway and Kelly Creek it would descend to the Fraser River via Cavanagh Creek. There is existing access on both sides of the Fraser, the river banks appear to be stable and the crossing span is short enough so that special towers would not be required.

The route would then cross the Camelsfoot Range via Leon and Junction Creeks. Heading northwest it would follow the Yalakom River valley to Quartz Mountain. At Quartz Mountain the route would head south down Noaxe and Tyaughton Creeks to just north of Gold Bridge.

Although much of the route across the Camelsfoot and Shulaps Ranges is at high elevation, the rolling terrain and existing access would make transmission line construction relatively easy. In a short section of Junction Creek Valley construction would be somewhat more difficult. There are minimal security hazards through this area.

D. Gold Bridge down Hurley River (UV)

North of Gold Bridge the route would follow the Hurley River and Donelly Creek south to the Lillooet River Valley.

Through the Hurley Valley existing roads from logging activity provide good access for transmission line construction. Care would have to be taken to avoid the numerous avalanche tracks throughout this area. Some structure protection could be required.

E. Gold Bridge to Bridge River Valley (UW)

Another alternative leaving the area just north of Gold Bridge would be for the route to follow the north side of Gun Lake and Downton Lake southwest and then the Bridge River valley to McParlon Creek. There is no existing access in this area and road construction would be difficult.

F. Bridge River Valley to Meager Creek via Pebble Creek (WX)

This route from Bridge River Valley would follow McParlon and Pebble Creeks to the Lillooet valley at Meager Creek. The size and number of avalanches in the McParlon and Pebble Creek Valleys eliminates the possibility of secure routes through them. Only with specially designed structures and/or "catenary construction" could this route be considered for a transmission line. Catenary

construction is conductors suspended from cables extending across the valley and anchored into rock on either side.

G. Bridge River Valley to Meager Creek via Salal Creek (WZX)

From Bridge River Valley this route would follow Salal Creek to Meager Creek. As with the McParlon and Pebble valleys the number of unconfined and slab type snow avalanches in this area eliminate it as a secure transmission line route unless special and costly design provisions are made.

H. Lillooet River Valley (VX)

From Donelly Creek this route would head west up the Lillooet River to Meager Creek.

The Lillooet River valley in this section appears to be suitable for two lines with acceptable security. Considerable protection from the numerous avalanches would be necessary, and where the lines would be on the valley floor, protection from flooding and channel shifts would be required.

There is a road in the Lillooet River valley bottom, but due to the steepness of the valley sides, access to the transmission line located on the sidehill would be difficult in some areas.

## I. Lillooet River to Cheekye (VT)

From the junction of the Hurley and Lillooet River valleys this route would continue south via Ryan, Rutherford and Callaghan Creeks. At Brandywine this alternative intersects the Cheakamus valley and the three existing transmission lines located there. Rather than replace circuit 2L1, which is the plan for a line following the preferred route, a line following this route would remain on the west side of the valley south down to Cheekye and 2L1 would not be removed.

Through the upper Ryan River and through the pass into the upper Rutherford, the steep rock sidehill and numerous avalanches would make transmission line construction difficult and costly. However, with careful structure placement and some protection an acceptable secure alignment could be established. With the exception of the pass area, existing logging roads would provide access. From Rutherford Creek the line would head south to the Soo River valley. Immediately west of Rainbow Mountain, the line would ascend to an elevation of 1400 metres and then descend into the Callaghan valley (this is segment OS in the Summary report). There is no access into the pass west of Rainbow Mountain. Protection from snow movement would be required for all structures in the pass. Further investigation would have to be carried out to determine the design parameters for a double circuit line located in the pass.

J. Meager Creek to Cheekye (XT)

From Meager Creek the route would cross into the Elaho valley, down the Elaho to the Squamish River and down the Squamish to Cheekye substation.

From Meager Creek down the Elaho River as far as Sims Creek there presently is no access. The necessary roads for transmission line construction could be developed relatively easily due to the easy terrain. Apart from possible high conductor loadings at the summit between Meager Creek and the Elaho River there are no specific difficulties or security hazards in this area.

Between Sims Creek and the confluence of the Squamish and Elaho Rivers the valley becomes narrower with steep side slopes. The line would be located on the steep rock sidehill where access to structure sites would be difficult.

In the upper Squamish River valley the line would be located both on the valley bottom and in some areas on the sidehill. Protection from flooding or debris flows could be required and structures would have to be located to avoid snow slides.

Between Cheakamus Generating station on the Squamish River and Cheekye substation there has been no recorded slide or flood related outages on the existing 19 kilometres of 230 kV line during the last 24 years. Another line in this area would therefore be considered secure.

## K. Cost Estimates

Once all of the segments are evaluated, the costs of constructing the tranmsission line on each segment are estimated.

The cost estimates are derived by taking into consideration all of the previously mentioned technical factors and such items as inflation, overhead and interest during construction. The segments are then combined to compose eight possible alternate routes from Kelly Lake Substation to Cheekye Substation.

Table 1 shows these alternate route lengths and costs. Note that these costs are intended solely for the relative comparison of route alternatives. The total lengh and cost of the preferred route as described in the Summary Report has also been included. From Table 1 it can be seen that the preferred route is in the order of half the cost of the northwestern alternatives.

## NORTHWESTERN ROUTE ALTERNATIVES FOR KELLY LAKE - CHEEKYE 500 kV TRANSMISSION LINE

| ROUTE ALTERNATIVES | TOTAL LENGTH (km) | TOTAL COST $ X1000 |
|---|---|---|
| ALTERNATIVE I (ABDGJUVXT) | 284.5 | 648,000 |
| ALTERNATIVE II (ABCEUVXT) | 288.0 | 656,000 |
| ALTERNATIVE III (ABDGJUVT) | 240.0 | 510,000 |
| ALTERNATIVE IV (ABCEUVT) | 243.5 | 519,000 |
| ALTERNATIVE V (ABDGJUWXT) | 269.5 | 636,000 |
| ALTERNATIVE VI (ABCEUWXT) | 273.0 | 644,000 |
| ALTERNATIVE VII (ABDGJUWZXT) | 288.0 | 693,000 |
| ALTERNATIVE VIII (ABCEUWZXT) | 291.5 | 701,000 |
| PREFERRED ROUTE IDENTIFIED IN SUMMARY REPORT | 192.5 | 356,000 |

TABLE 1 - THE SEGMENTS ARE USED TO COMPOSE THE EIGHT POSSIBLE ROUTE ALTERNATIVES.

- COSTS SHOWN ARE PRELIMINARY ESTIMATES ONLY AND ARE INTENDED SOLELY FOR THE COMPARISON OF ALTERNATE ROUTES.
- COSTS INCLUDE INTEREST DURING CONSTRUCTION, CORPORATE OVERHEAD, AND INFLATION TO 1988.

## V. CONCLUSIONS

The foregoing analysis shows that the preferred route described in the Summary Report is the most feasible and economical. This route is adjacent to transmission line 5L42 between Kelly Lake and Shalalth and then makes maximum use of the 2L1 right-of-way from Shalalth to Cheekye. The other transmission line routes to the northwest are technically more difficult, involve longer routes, are less secure, and cost more. Environmental impacts can also be expected to be proportionally greater for these alternate routes since much more land would be disturbed. However, since the routes covered in this report are ruled out due to economic concerns no environmental studies are planned for them. The development costs of the proposed Creekside substation do not affect the comparison of the routes studied.

# KELLY LAKE - CHEEKYE 500 kv
# DOUBLE CIRCUIT TRANSMISSION LINE

## TECHNICAL EVALUATION TABLE

| EVALUATION COMPONENTS | RATINGS: LOW → HIGH | | | | |
|---|---|---|---|---|---|
| | I | II | III | IV | V |
| DESIGN CONSIDERATIONS<br>-Topography<br>-Conductor Loading<br>-Deflections | no sidehill<br>light loading<br>low percent of deft | rolling, some sidehill<br>light loading<br>medium percent of deft | 30% average sidehill<br>medium loading<br>med-high percent of deft | over 30% average sidehill<br>high loading<br>high percentage of deft | extreme sidehill<br>extreme loadings<br>individual site selection |
| ACCESS | Good existing access from other linear developements | Access to R/W at frequent points not far from existing roads New roads construction easy | some access, new road construction possible | no existing access, new road construction difficult | inaccessible to vehicles |
| CLEARING | Little clearing, range land with scattered individual trees | easy machine clearing | moderate machine clearing, some hand clearing | Extensive hand clearing, forests that will not be difficult | Totally hand cleared, stee, densely forested slopes |
| SPECIAL CONSIDERATIONS | none | minimal | moderate | high | extreme |

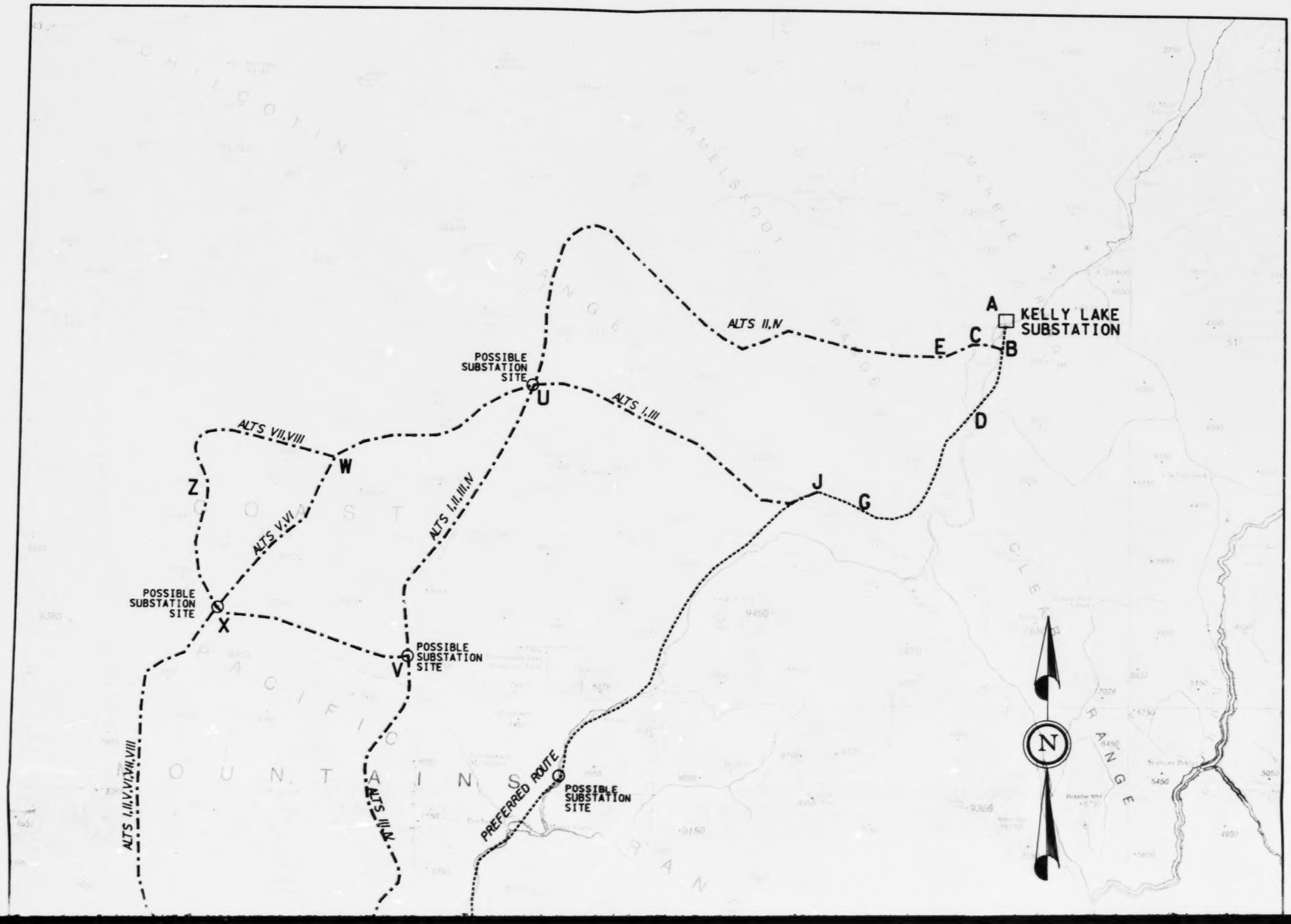
TABLE A-1 - THESE RATINGS ARE APPLIED TO EACH SEGMENT OF THE ROUTES STUDIED.
REFER TO TABLE A-2.

[12,1]KLYTAB

# KELLY LAKE - CHEEKYE 500 kV
# DOUBLE CIRCUIT TRANSMISSION LINE
## TECHNICAL RATINGS AND COSTS

| SEGMENT | | A-B | B-C-E-U | B-D | D-G | G-J | J-U | U-V | U-W | W-X | W-Z-X | V-X | V-T | X-T |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LENGTH (km) | | 5.0 | 97.0 | 12.5 | 24.0 | 7.0 | 50.0 | 47.5 | 33.0 | 29.0 | 47.5 | 29.5 | 94.0 | 109.0 |
| EVALUATION COMPONENTS | DESIGN CONSIDERATIONS | II | 60%-II 40%-III | I | II | II | IV | 25%-II 75%-III | III | V | V | IV | 30%-I 70%-III | 80%-III 20%-I |
| | ACCESS | I | III | I | I | I | III | II | III | IV | IV | III | 35%-I 35%-II 30%-III | III |
| | CLEARING | II | II | I | II | II | IV | 25%-II 75%-III | III | IV | IV | III | 55%-II 45%-III | 40%-II 60%-III |
| | SPECIAL SONSIDERATIONS | I | 65%-II 35%-III | I | III | II | III | 25%-III 75%-IV | III | V | V | IV | 35%-I 35%-II 30%-III | 40%-II 60%-III |
| TOTAL COST ($X1000) | | 8900 | 211,000 | 21,000 | 43,000 | 14,000 | 126,000 | 102,000 | 75,000 | 90,000 | 147,000 | 76,000 | 196,000 | 258,000 |

TABLE A-2 - THE RATINGS APPLIED ARE DEFINED IN TABLE A-1.
- THE COST ESTIMATES INCLUDE INTEREST DURING CONSTRUCTION, CORPORATE OVERHEAD AND INFLATION TO 1988.

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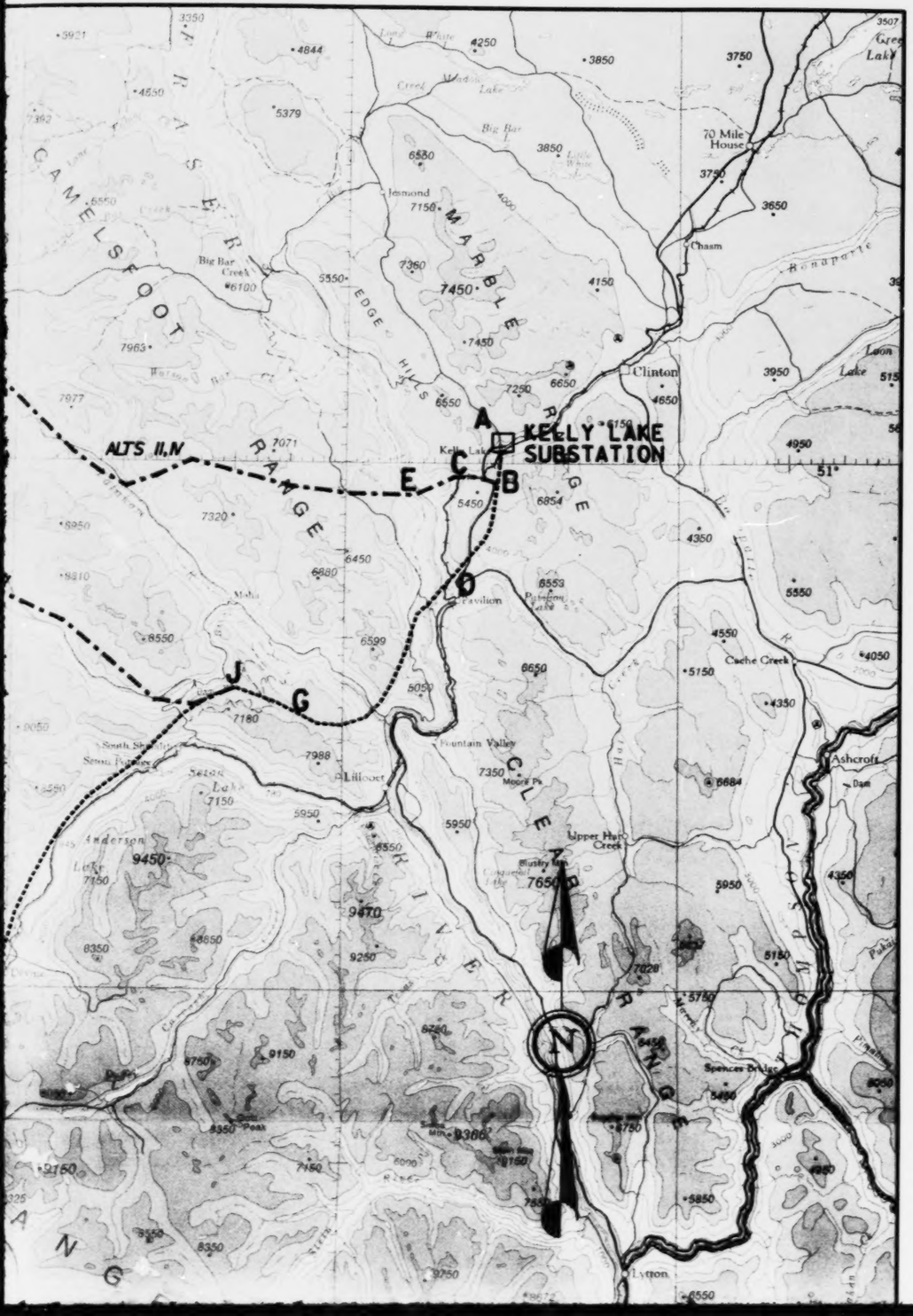
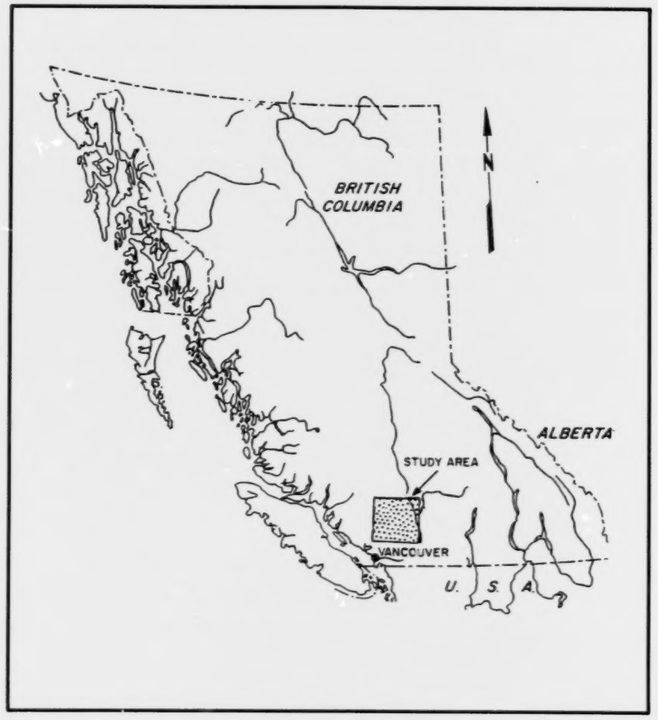
# ROUTE STUDY PLAN



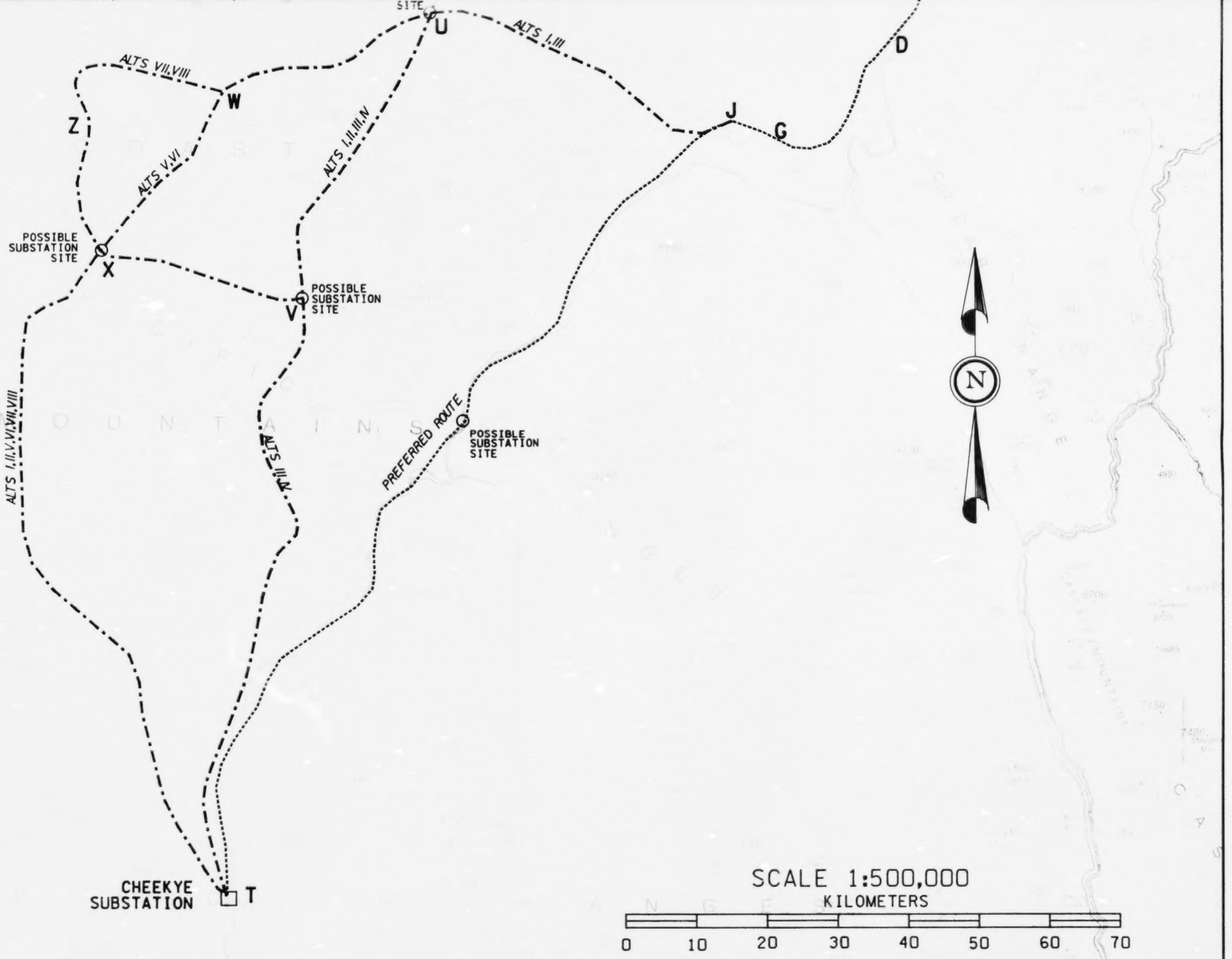




KEY PLAN

## LEGEND

..... PREFERRED ROUTE AS DESCRIBED IN THE SUMMARY REPORT

-.-.-.-.- NORTHERN KELLY LAKE - CHEEKYE ROUTE ALTERNATIVES

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# ALTERNATIV
# KELLY LAKE
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KEY PLAN

POSSIBLE SUBSTATION SITE

PREFERRED ROUTE

POSSIBLE SUBSTATION SITE

SCALE 1:500,000
KILOMETERS
0 10 20 30 40 50 60 70

## LEGEND

PREFERRED ROUTE AS DESCRIBED IN THE SUMMARY REPORT

NORTHERN KELLY LAKE - CHEEKYE ROUTE ALTERNATIVES

NOTE:
ROUTE LOCATIONS SHOWN ARE APPROXIMATE ONLY

# NORTHWESTERN ROUTE ALTERNATIVES FOR THE KELLY LAKE - CHEEKYE 500 kV DOUBLE CIRCUIT TRANSMISSION LINE

FIGURE 1 APRIL 1982